An Inspection on Sustainable Construction Materials

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***Abstract*—As we know that there are various factors that affect the environment of earth. This is due to the increment of waste, higher pollution rate, increment in carbon emissions, deforestation etc. These certain factors will affect the lifecycle on earth and increasing the temperature of earth. To mitigate or to overcome these challenges we need to adopt some sustainable construction practices and materials for contributing to maintain earth's lifecycle and its atmosphere. However, the construction industry encountering increasing pressure to acquiring sustainable construction practices to eliminate the environmental impacts on earth. Sustainable construction materials play an important role in obtaining these goals by minimizing waste generation, decreasing carbon emissions, etc. Therefore, this research paper gives a comprehensive review on advancing techniques to adopt sustainable construction materials. It explores certain varieties of sustainable materials such as bamboo, coconut fiber, human hair fiber etc. These sustainable materials may contain various properties like durability, sustainability, recyclability, reduced environmental impact and more. This research paper also comments on various barriers to extend the adoption of sustainable construction materials and its practices along with technological limitations, cost consideration, etc.**

***Index Terms*—sustainable construction material, human hair fiber reinforced concrete, BFRC, FRC, durability, pollution rate, deforestation, compressive strength, flexural strength, etc.**

I. INTRODUCTION

Sustainable construction materials is defined as those materials that are utilized and transported in a way that mitigates the negative impact on human health as well as the environment. These are the materials that are used in the construction and building industry that are sourced in a way that minimize the environmental impact. The sustainable construction materials are efficient in resources, from extraction to disposal. Different - different sustainable materials are used according to their ability and demand in the construction field without hampered the ability of future generation to meet their own needs. The sustainable material that are used in the construction field are non-toxic and they also play an important role in the waste minimization. The use of sustainable materials also provides the healthy living and a healthy workplace environment. Hence, these construction materials are called durable as well as environmentally friendly.

Figure: Sustainable Materials

II. CHARACTERISTICS OF SUSTAINABLE CONSTRUCTION MATERIALS

1. RECYCLED MATERIALS: Utilizing various recycled materials such as reclaimed wood, glass, metal and other materials that will help in to reduce the waste the also helps in the utilization of resources.
2. ENVIRONMENTAL IMPACT: The use of the sustainable construction materials helps in to

minimizing the environment impact throughout their lifetime. This may include various factors such as reducing greenhouse gas emissions, reducing water usage, reducing energy consumption etc.

3. SOCIAL EQUITY: There is also a factor of social equity that is considered by the sustainable construction materials by promoting the reasonable labor practice, community engagement, etc; by ensuring that the construction materials are produced and used in a reasonable manner that will be beneficial for workers and others.
4. DURABILITY AND LONGEVITY: Used those materials that are long - lasting, reducing the need of too much replacement, reducing waste generation and also requires minimum maintenance. Hence sustainable construction materials are designed to be long-lasting, durable etc. Durable construction materials lead to long life of the structure or building.
5. LOCAL SOURCING: Sustainable Construction Materials also leads to promoting the locally available sustainable materials that will reducing the transportation cost. Due to this, an overall construction cost of a project will also decrease.
6. HEALTH SAFE & NON- TOXIC: The sustainable construction materials also view on the human health and their well-being by reducing the exposure to the toxins, pollutants, harmful chemicals. Non-toxic materials help in to create a healthy environment and improving the quality of air and provides the comfort to be people who are occupants.

III. BAMBOO FIBER REINFORCED CONCRETE

Bamboo Fiber Reinforced Concrete is defined as the concrete that bamboo fibers as a reinforcing material. These bamboo fibers are derived from the bamboo plants which are added to the concrete mix that improves the performance characteristics as well as mechanical properties of concrete. Bamboo Fiber Reinforced Concrete provides various advantages as compared to the conventional concrete such as improve durability, improve crack resistance, increased tensile strength, reduced negative environmental impact, etc. Bamboo Fiber Reinforced Concrete has one of the major benefits is its ability to increased ductility and tensile strength of concrete. Therefore, this increased ductility makes Bamboo Fiber Reinforced Concrete suitable for various applications such as for impact or dynamic loading. There are various applications of Bamboo Fiber Reinforced Concrete such as bridges, pavements, floors etc.

Figure: Bamboo Fiber Reinforced Concrete

Bamboo Fiber Reinforced Concrete also participate in climate change elimination by using bamboo fibers, which are mainly contains carbon-rich organic compounds and cellulose.

IV. HUMAN HAIR FIBER REINFORCED CONCRETE

A Human Hair Fiber Reinforced Concrete is defined as the type of concrete that contains human hairs in it as a reinforcing material. This type of approach used human hairs to improve the performance characteristics and mechanical properties of HHFRC or concrete. There are certain advantages of Human Hair Fiber Reinforced Concrete over conventional concrete such as improved durability, increased crack resistance, improves tensile strength etc. Human Hair Fibers are flexible and contains lightweight which helps in to provide tensile strength. A Human Hair Fiber Reinforced Concrete provides improved resistance to thermal cracking and shrinkage. There are various applications of Human Hair Fiber Reinforced Concrete such as they are used in pavements, industrial floor, building, etc. Human Hair can be obtained from various places such as salons, industries, barbershops, etc. Therefore, the use of

Human Hair provides a waste minimization technique as it can be used as a construction material. Human Hair Fiber Reinforced Concrete helps in the reduction of pollution as well as carbon emissions. Human Hair Fiber Reinforced Concrete helps in to reduce greenhouse gas emissions and contributes and the reduction in climate change negative impact. Therefore, we can say that the Human Hair Fiber Reinforced Concrete can be used as a sustainable construction material in the construction industry. Human Hair Fiber Reinforced Concrete plays an important role in the more efficient and environmentally friendly construction material.

Figure: Human Hair Fiber Reinforced Concrete

V. COCONUT FIBER REINFORCED CONCRETE

Coconut Fiber Reinforced Concrete is defined as the concrete that contains coconut fibers in it which are used as a reinforcing material. These coconut fibers are obtained from husk of coconuts and then they are added to the concrete mixture to enhance the properties of concrete. Coconut Fiber Reinforced Concrete has various advantages such as increased tensile strength, durability, improved crack resistance, etc. The key benefits of CFRC is its ability to enhance ductility and tensile strength of that concrete. There are various applications of Coconut Fiber Reinforced Concrete such as it can be used in bridge decks, industrial floors, pavements etc. Coconut Fiber Reinforced Concrete improved resistance to thermal and shrinkage cracking. Coconut Fiber Reinforced Concrete has various environmental benefits because of its biodegradable nature of fibers. CFRC provides an environmentally friendly and a sustainable alternative to the conventional concrete. Coconut Fiber Reinforced Concrete provides better durability and reduced negative environmental impact.

Figure: Coconut Fiber Reinforced Concrete

VI. METHODOLOGY

Figure: Laboratory

Figure: Material Used

VII. LITERATURE REVIEW

1. Suhana Navas, Ruksana S, Riya Junaid etc (2022) did an experimental study on “Sustainable Building Replacing Normal Construction Materials with

Sustainable Materials" they said that the construction industry of the world is developing day by day with the increment of population. Therefore, the demand of raw material also increases. The energy consumption in the building sector is high. The manufacturing of building materials also responsible for the emission of Carbon dioxide in an unacceptable amount which contributes to the greenhouse effect. Hence, in the research they studied on completely replacing traditional material with sustainable material. They examined that in the future these resources can become endangered. So it's the right time to use sustainable construction materials for the construction practices.

2. Professor Dr. Moncef L. Nehdi (2018) did the experimental study on the topic of "Advances in Sustainable Building Materials and Construction" they said that the construction industry is considered as the most responsible field for contributing depletion in natural resources. Therefore, this topical collection hunt research study on carbon neutral construction materials. In this study both modeling and experimental studies will be considered.

3. Satyam Kumar, Vishal Puri, ML Aggarwal (2020) have studied on "Review of Sustainable Building Materials for Construction Industry" they have look on environmentally friendly, sustainable materials that contains various characteristics such as easy availability, energy efficiency and do not have any negative environmental impact. The main aim of these buildings materials is to mitigate the negative impact of construction practices on the environment as well as on human health.

4. Naraindas Bheel, Santosh Mehro, Carlos Alberto etc. (GTCC) (2020), did an experimental study and they told that the concrete is considered as the most consumed man made material all over the world. They used a human hair as a fiber in concrete (by Volume) of cement, sustainable development achievements can be obtained without any risk.

5. Naman P. Parikh, Dr. Mayank K. Desai, Akshay Modi (2016), they had studied on the topic of "Bamboo: A sustainable and low-cost housing material for India" they used bamboo as an additional construction material because bamboo has some structural properties. It also contains a high strength. The tensile strength of bamboo can be comparable to the steel. They used bamboo as a structural material that can reduce the cost of construction project to 35-40%.

6. Aliu Adekunle O, Olabisi Williams, Fakuyi Funmi (2022) they did an experimental study on the topic of "Feasibility of using coconut fibers to improve concrete strength" and they find that Concrete which is made up of coconut fibers may contains more load resistant and also capable to protect the concrete from breaking apart after failure as compared to the conventional concrete.

7. T. Naveen Kumar, Kamershetiy Gaoutami, V Raja Mahendar etc. in 2015 did an experimental study and they found that the optimum percentage of human hair fiber (HHF) which is added in the M40 grade of concrete in terms of its flexural strength, split tensile strength, compressive strength similar to the content of hair (by wt.) of cement in concrete.

8. Ritu, Satender Chillar (2017) did an analysis on the topic of "Sustainable Construction Materials for Buildings" they said that the sustainable construction is the path of adopting materials in the construction practices. The use of sustainable construction materials requires less utilization of natural resources. Additionally, the sustainable construction technique improving the resilience of the construction industry. From the quality and safety point of view, the performance of such structures and buildings which are made up of sustainable construction materials should remain high and strong.

VIII. RESULTS AND DISCUSSION

1. Human Hair Fiber:

Compressive Strength-

Cube of size 150mm×150mm×150mm was casted and curing is done for 7, 14 and 28 days. The test was performed by using compressive testing machine. The percentage of human hair were taken as 0%, 4% and 6%. The results are as below:

S. No.	No. of Days	% of Hair	Compressive Strength (MPa)
1	7 days	0%	15
2	14 days	0%	18.5

S. No.	No. of Days	% of Hair	Compressive Strength (MPa)
1	7 days	4%	17.5
2	14 days	4%	20

S. No.	No. of Days	% of Hair	Compressive Strength (MPa)
1	7 days	6%	19
2	14 days	6%	21.1

2. Bamboo:

The compressive strength of concrete was checked for 7 days and 28 days. The percentage of bamboo were taken as 0%, 2% and 4%. The flexural strength of concrete was checked for 28 days and 56 days. The percentage of bamboo were taken as 0%, 2% and 4% for flexural strength as well as for compressive strength.

Compressive Strength (MPa)

Bamboo %	7 days	28 days
0%	17	32.5
2%	15	29
4%	12.5	26

Flexural Strength (MPa)

Bamboo %	28 days	56 days
0%	4.5	5.5
2%	4.0	5.01
4%	3.1	5.0

3. Coconut Fiber:

Compressive Strength

S.	W/C	% of	Compressive

No.	Ratio	Coconut Fiber	Strength (MPa)	
			7 days	28 days
1	0.5	4%	14.5	25.5
2	0.5	5%	16.5	28.0
3	0.5	6%	15.0	26.5

IX. CONCLUSION

In this research paper, the inspection on sustainable construction materials is not only plays an important role in the critical step in ensuring the structural longevity as well as integrity of construction projects but also a cornerstone for advancing environmental stewardship in the construction industry and in its practices. The investigation about the sustainable construction materials in this research paper plays an important role in shaping an eco-friendly, resources efficient and resilient environment. By utilizing sustainable materials, one can reduce carbon emissions, improves etc. that balance the environmental impact with societal needs. As we know that the technology is evolving day-by-day, the integration of comprehensive inspection systems will plays an important role in observing the effectiveness of the sustainable construction materials, ensuring that their advantages are maximized. Ultimately, supporting sustainable construction materials will be essential for shaping a resilient, eco-friendly future for the built environment. The use of sustainable construction materials will also provide a waste minimization technique that will affect the environment as well as human positively. The use of sustainable construction materials will help in to prevent the natural resources on our planet.

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